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A REVISIONAL STUDY OF THE GENUS SCOLYTUS GEOFFROY (ECCOPTOGASTER HERBST) IN NORTH AMERICA[1]

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INTRODUCTION

For several years field workers of the Division of Forest Insects of the Bureau of Entomology have been hampered by the uncertainty that exists regarding the identity of several of Leconte's species of *Scolytus* and by the fact that a number of more or less common western species are without names. With the beginning of intensive field investigation of certain fir engraver beetles associated with the dying of fir trees, particularly in recreational areas in the Pacific Coast States, it became important that the identity of such associated species of *Scolytus* be definitely determined. It was especially desirable to establish the identity of *S. ventralis* Leconte, *S. subscaber* Leconte, *S. sulcatus* Leconte, and *S. californicus* Leconte.

[1] The writer wishes to express his gratitude to J. M. Miller, of this Bureau's Pacific coast laboratory (Berkeley, Calif.), for the adequate series of *Scolytus subscaber*. Through his active and critical interest it is now possible definitely to establish the identity of this species, which appears not to have been taken since the time of Leconte. Thanks are also due to J. C. Evenden and W. D. Bedard, of the Coeur d'Alene (Idaho) laboratory, and F. P. Keen, of the Portland (Oreg.) laboratory, for valuable material from their respective regions; to J. M. Swaine for the opportunity to study the types of his species of *S. tsugae* Swaine and *S. monticolae* Swaine; and to Nathan Banks for making the Leconte collection available for study.

Swaine, in his epochal Canadian Bark Beetles (*39*, *40*),[2] established the identity of most of Leconte's species. His work indicated rather conclusively the identity of *S. ventralis*, but unfortunately he was not able definitely to separate it from *subscaber*. In fact *subscaber* has often been confused with *ventralis*, perhaps partly because Leconte's type series contains but one specimen of *subscaber* and several specimens of *ventralis*, and especially because only the female of *subscaber* has been known. Recently, however, J. M. Miller, in charge of field work on forest insects in California, has sent in a number of specimens comprising both males and females, the females of which the writer finds to agree with Leconte's type of *S. subscaber*.

ECONOMIC IMPORTANCE OF THE GENUS

The genus *Scolytus* is not only of taxonomic interest as the chief North American representative of one of the main subdivisions of the bark beetles, but it also contains species that are of considerable economic importance as well.

One of the most destructive forest insects in the Eastern States is the hickory bark beetle (*S. quadrispinosus* Say), which under favorable climatic conditions kills large numbers of hickory trees of all species. Thousands of these trees in central New York were killed by this species during the years 1912 to 1923 (Blackman, *2*, *4*). Similar outbreaks have occurred at various times elsewhere in the eastern half of the country, and it seems certain that the hickory bark beetle is the the most serious enemy of hickory trees in this region.

The fir bark beetle (*Scolytus ventralis*), while perhaps not quite so deadly as the hickory bark beetle, is of decided economic importance. For many years it has been observed that considerable numbers of fir trees, *Abies concolor* especially, have been dying each year in the Pacific Coast and Rocky Mountain States. The burrows of *S. ventralis* are nearly always found in such trees, and there is evidence that this beetle, by its attacks over a period of years, is an important factor in the death of the trees. The relationship between these bark beetles and certain other organisms, the combined activities of which kill the trees, is the subject of research by other members of the Division of Forest Insects. The destruction of white fir trees would not be of great importance if we considered only their timber value, but in recreational areas this tree is a valuable one and its destruction means not only an esthetic loss but a financial one as well.

Several other western species of bark beetles are apparently just as aggressive as *S. ventralis* but at present are not of economic importance because the trees they affect are not of great value. With the further development of recreational areas, home sites, and so forth, the insect enemies of many trees now considered of little value will assume a much greater economic importance.

In addition to the native species of *Scolytus*, two species have been accidentally introduced from Europe and have occasioned considerable anxiety in recent years. Other introductions, some of which may prove of greater importance, will be prevented only by continued vigilance. The two introduced species already established are the shot-hole borer, or fruit tree bark beetle, (*S. rugulosus* Ratz.) and the smaller elm bark beetle (*S. multistriatus* Marsh.).

[2] Italic numbers in parentheses refer to Literature Cited, p. 28.

The shot-hole borer has been known in this country since 1878, when it was reported from Elmira, N.Y., by Leconte (Hubbard and Schwarz, *21*). In a very few years it was known from Massachusetts, New York, New Jersey, Pennsylvania, Maryland, North Carolina, and Missouri. It soon became distributed throughout most of the States east of the Rocky Mountains and in southern Ontario, and it has more recently been reported in New Mexico, California, and Oregon. Damage by this species is usually confined to orchards where sanitation has been neglected and the vigor of the fruit trees has been allowed to deteriorate.

The smaller elm bark beetle was first reported in this country in 1910 from Cambridge, Mass., by Chapman (*9*). Here it was found breeding in the larger limbs and tops of elm trees weakened by the leopard moth (*Zeuzera pyrina* L.). It is not known to be responsible for independent injury, but it breeds in trees decadent from the attacks of other insects or from other causes. It has not spread so rapidly as the shot-hole borer, but the writer has seen specimens taken in Massachusetts, in Connecticut, on Long Island and elsewhere in New York, in Pennsylvania, and in New Jersey. At the present time (1934) it is abundant in the vicinity of Newark, N.J., and appears to be closely associated with the Dutch elm disease, a serious outbreak of which has recently been discovered there. The possible insect vectors of this disease are being investigated and the preliminary evidence seems to point unmistakably to the smaller elm bark beetle as an important agent in its transmission.

Another European form, *Scolytus scolytus* (Fab.), is not known to be established in this country. This species, known as the larger elm bark beetle, is an important vector of Dutch elm disease in Europe and is also important as an enemy of elm trees on its own account. Several recent shipments of logs from Europe to veneer factories in this country have been intercepted and found to contain living adults and brood of this bark beetle (as well as several other species of insects); so it would not be surprising to find that it has been established either at the ports of entry or in the vicinity of veneer factories.

NOMENCLATURE

The status of the names *Scolytus* Geoffroy (1762) (*14, v. 1, p. 310*) and *Eccoptogaster* Herbst (1793) (*15, p. 124*) has been the subject of considerable dispute during recent years, although prior to the beginning of the present century the former name was accepted as valid by all but a few workers on the group. This dispute was rendered acute in 1903 by the attack of Ganglbauer (*13*) and his supporters on the validity of Geoffroy's name, Weise (*43*) being the leader in the opposing views.

The ruling of the Fifth Zoological Congress in 1901 which established the present law of priority was intended to put an end for all time to the question of the validity of genera and species. However, it seems not to have had this effect, in the case of Geoffroy's names at least, owing to the difference of opinion as to the exact meaning of "binary nomenclature" and also as to what constitutes an adequate description or definition.

Thus, Hopkins (*18, 19*) and a few other workers on the bark beetles have held firmly to Geoffroy's name, while Reitter (*28, 29*) and

Spessivtseff (36) have wavered. Swaine (*37*, *40*), following Ganglbauer (*13*), Trédl (*41*), and others, substituted the generic name *Eccoptogaster* Herbst for *Scolytus* Geoffroy and was followed in this by several others, including the present writer (Blackman, *1*, *2*). In 1918 Swaine (*40*) gave as his reason for rejecting *Scolytus* Geoffroy his opinion that "Geoffroy's description seems entirely inadequate", his use of binary as opposed to binomial names, and his failure to designate a species.[3] Others have advanced similar reasons for rejecting *Scolytus* Geoffroy.

The rules distinctly state that binary names are acceptable. Geoffroy mentions only one "species", describes it, and illustrates it, and both description and illustration are at least as good as those of the majority of writers of his time whose species and genera have in most cases been accepted without question by later workers. Both Fabricius (*11*, *p. 59*) in 1775 and Linné (*24*) in 1788, as well as Müller (*26*) in 1764 and Schaeffer (*34*) in 1766, apparently proved the adequacy of the description by recognizing the species in question, although the first two of these assigned it to another genus (*Bostrichus*).

It would seem, then, that the rejection of Geoffroy's genus *Scolytus* has been contrary to the letter and spirit of the law of priority and has resulted in a grave injustice to one of the ablest entomologists of his time.

A peculiar aspect of the situation has more recently (1923) been brought to light by Sampson (*32*), who states:

> Dr. A. F. Fourcroy, in 1785, published a small book in Paris entitled "Entomologia Parisiensis", the preface of which states that the trivial [i.e., specific] names therein were added by Geoffroy himself to rectify the omissions in his original work, and on page 139 of the first volume the specific name of "*niger*" is added to *Scolytus*.

This would seem unquestionably to establish priority for *Scolytus* Geoffroy over *Eccoptogaster* Herbst, although in the present writer's opinion the original publication was sufficient. Of course this does not alter the status of the specific name (*scolytus*) proposed by Fabricius in 1775.

For other discussions of this controversy reference may be made to Hopkins (*19*, *pp. 219*, *220*), Swaine (*40*, *pp. 50*, *51*), and Von Butovitsch (*6*, *pp. 2–5*). The last-named especially discusses the question in considerable detail, particularly regarding the controversy between Ganglbauer, Weise, and others.

HISTORY OF THE SPECIES OCCURRING IN NORTH AMERICA

Say's description (*33*, *pp. 323–324*) of *Scolytus quadrispinosus*, which appeared in 1826, applies only to the male and allows it to be readily recognized. The female, however, as is often the case in this genus, is quite different in the structure of the abdomen and was described as a distinct species under the name *S. caryae* by Riley in 1867 (*30*). Riley's type series, now in the United States National Museum, contains many typical males of *quadrispinosus* Say as well as many of the females described as *caryae* Riley, and it would seem that the identity of *caryae* and *quadrispinosus* might well have been inferred by the presence of the two in the same host and habitat. Leconte in 1868 (*44*) recorded *quadrispinosus* Say and *caryae* Riley

[3] Swaine in personal letters now states that he is convinced of the validity of *Scolytus* Geoffroy.

as separate species, the latter based on "three specimens which show no sexual difference." However, in 1876 Leconte (*22*) placed *caryae* as a synonym of *quadrispinosus*, a disposition of the name which Riley (*31*) accepted in 1881.

Scolytus muticus Say (*33*) is described on the same page as the preceding species. The characters are so distinctive that it has been recognized by later workers almost without exception.

Eccoptogaster (=*Scolytus*) *rugulosus* Ratzeburg was described from Germany (*27*) in 1839, and was first noted in North America by Leconte (Hubbard and Schwarz, *21*) in 1878. The numerous references to it in American literature deal for the most part with the economic rather than the taxonomic aspects.

Scolytus fagi Walsh was described (*42*) in 1867. Only a few references to this nonabundant species are in the literature.

Scolytus californicus Leconte was described (*44*) in 1868 from a single specimen obtained from Andrew Murray and purporting to have come from California. No authentic specimens have been taken since, although Smith (*35*) reported it in 1886. It is apparently identical in all respects to *S. scolytus* (Fab.).

Scolytus sulcatus Leconte was described (*44*) in 1868 from a single specimen bearing a New York locality label. No other authentic specimen was collected until September 1933, but since then it has been taken on several occasions in connection with investigations on the Dutch elm disease and its insect vectors.

Scolytus ventralis Leconte was described (*44*) in 1868 from two specimens taken in Washington State. Other samples of this species were associated by Leconte with his types of *subscaber* and *ventralis*. It remained unrecognized until the publication of Swaine's key and brief description (*40*). Hopping (*20*) lists as hosts *Pseudotsuga taxifolia, Abies concolor, A. grandis*, and *A. magnifica*.

Scolytus unispinosus Leconte was described (*22*) in 1876 from two male specimens taken in Oregon. In 1878 Leconte (Hubbard and Schwarz, *21*) recorded a specimen taken in Michigan, but in 1879 Leconte (*23*) pointed out the differences between this specimen and *unispinosus*. The specimen in question is almost certainly *S. piceae* Swaine, described many years later. In 1879 Leconte (*23*) also recorded *unispinosus* from Colorado. Smith (*35*) in 1886 gave a brief account of its biology. Swaine (*40*) and Hopping (*20*) reported this species as common on Douglas fir in western Canada. Hopkins (*16, 17*) and Currie (*10*) in 1905 recorded it from red fir and western larch in the Pacific coast, Cascade, and Rocky Mountain regions. Chamberlin (*7*) in 1917 added *Picea engelmannii* as a host.

Scolytus praeceps Leconte was described (*22*) in 1876 from specimens taken in California, both sexes being represented. Later references by Hopkins (*16, 17*) and Currie (*10*) give the hosts as white fir and grand fir and the distribution as California and Idaho. Fall and Cockerell (*12*) in 1907 reported it from New Mexico.

Scolytus subscaber Leconte was described (*22*) from a composite series, the type specimen being from Vancouver Island. Leconte's type series includes also other specimens from Oregon and California, but these are really *S. ventralis*. Later references to it by Hopkins (*17*), Currie (*10*), Fall and Cockerell (*12*), Burke (*5*), and Chamberlin (*8*) appear to have been based on erroneous determinations and should apply to *S. ventralis*.

Eccoptogaster (=*Scolytus*) *piceae* Swaine was described (*38*) in 1910 from specimens taken in Quebec, Canada, from *Picea canadensis*. It was later (1918) found breeding in eastern larch in New York by Blackman and Stage (*3*), and Swaine (*40*) in the same year reported it as occurring throughout Canada as far west as Alberta.

Eccoptogaster (=*Scolytus*) *tsugae* Swaine was described (*39*) in 1917 from British Columbia and Alberta, the hosts being mountain hemlock and Douglas fir.

Eccoptogaster (=*Scolytus*) *monticolae* Swaine was described (*39*) in 1917 from specimens taken from white pine and Douglas fir in British Columbia.

Scolytus multistriatus was described by Marsham (*25*) in 1802. It is a European form first seen in this country at Cambridge, Mass., and reported by Chapman (*9*) in 1910.

DESCRIPTION OF THE GENUS

The body form is cylindrical, stout, usually but little more than twice as long as wide; the color, brown to black, usually shining; the sculpture, weak to moderate, with the pubescence on the upper surface usually sparse.

The head has the front usually flattened and more hairy in the male, and convex in the female. The eye is elongate, wider above, with the inner line broadly and shallowly emarginate. The antenna has the scape short, the funicle seven-jointed and shorter than the club, which is flattened, irregularly ovate, with three sutures, the first distinct and sclerotic, the others indistinct.

The anterior legs have the tibiae stout, the edges nearly parallel and devoid of teeth, produced into a prominent curved process at the outer distal angle, the inner angle acute but not produced beyond the tarsal insertion; the tarsi are slender, often nearly as long as the tibiae, the third joint more or less strongly bilobed.

The pronotum is large, more or less strongly constricted near the anterior margin, the disk usually finely punctured, with an elevated margin at the sides and behind.

The scutellum is large, triangular, more or less deeply depressed between the elytra.

The elytra are shining, the bases without an elevated margin, often scabrous in the females, not declivitous but usually slightly depressed at the apex.

The venter of the abdomen is either concave or ascending abruptly behind, often with the second, third, and fourth sternites ornamented with carinae, tubercules, spines, or elevated margins, especially in the males; the fifth sternite is often shorter in the males.

KEY TO THE NORTH AMERICAN SPECIES

A. Abdominal sternites unarmed in both sexes, the second not concave; elytra with their bases not strongly scabrous in either sex.

B. Elytra clothed with hairs over entire surface, striae and interspaces about equally impressed; epistomal process reduced or lacking.

C. Smaller, less than 2.5 mm long; elytra with short hairs over entire surface; frons feebly convex, aciculate to margin, with epistomal process reduced; venter of abdomen gradually ascending, suture between first and second sternites not elevated to form a marginal line, fifth sternite not sulcate in either sex ..... *rugulosus* Ratz. (p. 10).

CC. Larger, usually about 4.00 mm long; elytra with long hairs over entire surface; frons very broadly flattened in both sexes, feebly concave in male, epistomal process lacking, margin smooth; fifth sternite of male with median sulcus.
muticus Say (p. 11).

BB. Elytra with disk glabrous, striae more deeply impressed than interspaces; epistomal process variable.

C. Fifth sternite lacking an elevated posterior margin in one sex; elytra with humeri less prominent.

D. Elytra with striae distinctly impressed, punctures markedly coarser than on interspaces; frons densely granulate-punctate, epistomal process obsolete; fifth sternite of male without an elevated posterior margin, that of female with distinct margin, closely punctured.
fagi Walsh (p. 11).

DD. Elytra with striae weakly impressed, punctures but little coarser than on the interspaces; frons finely aciculate-punctate, epistomal process reduced; fifth sternite without an elevated posterior margin in the unique type, moderately punctured ---------- *sulcatus* Lec. (p. 12).

CC. Fifth sternite with an elevated posterior margin in both sexes; elytra with humeri more prominent.

D. Fifth sternite short in both sexes, in male scarcely longer than fourth sternite, posterior margin subangulately rounded, very strongly elevated especially in male; third and fourth sternites with longer hairs at sides; elytra with striae weakly to moderately impressed, apex usually notched opposite third interspace; epistomal process more narrowly and deeply emarginate.

E. Fifth sternite in male with posterior margin strongly extended in median line and recurved, subrostriform; second sternite less strongly margined in front; elytra more strongly notched at apex.
reflexus, n. sp. (p. 13).

EE. Fifth sternite in male with posterior margin strongly elevated but not subrostriform in median line; second sternite more strongly margined in front; elytra less strongly notched at apex.
wickhami, n. sp. (p. 13).

DD. Fifth sternite longer in both sexes, in male nearly as long as third and fourth combined; third and fourth sternites with hairs at sides not notably longer; elytra with apex usually not notched; epistomal process more broadly and shallowly emarginate.

E. Elytral striae usually feebly impressed, punctures small, interspaces not at all or feebly impressed; second sternite shining, punctures fine but deep; usually smaller ---------- *monticolae* Swaine (p. 15).

EE. Elytral striae usually rather strongly impressed, punctures coarser, interspaces usually distinctly impressed; second sternite opaque or subopaque, finely but not so deeply punctured; usually larger ---------- *tsugae* Swaine (p. 15).

AA. One or more of abdominal sternites carinate, tuberculate, or armed with one or several teeth or spines in male at least (sometimes reduced or even lacking in *subscaber* Lec., *praeceps* Lec., *oregoni*, n. sp., and *robustus*, n. sp.); second sternite either concave or convex; base of elytra usually scabrous in female.

B. Second sternite, in male at least, deeply concave, with anterior margin strongly extended, and typically carinate in median line; female with second sternite either similar or convex with a more weakly elevated anterior margin and carina reduced or lacking.

C. Frons of male very broadly, feebly concave, fringed with long incurved hairs, in female feebly convex and hairs sparser; antennal club very broad, 1.2 times as

long as wide; second sternite with a median carina in male, third and fourth with spines, fifth very short; in female, venter of abdomen opaque, unarmed, fifth sternite as long as third and fourth together; elytra with striae coarsely punctured, strongly impressed, base not scabrous in either sex ..... *quadrispinosus* Say (p. 16).

CC. Frons of male not so broadly flattened, with hairs usually sparse and more evenly distributed, that of female convex; antennal club usually more than 1.5 times as long as wide; second sternite armed in male at least, others unarmed; fifth sternite concave in both sexes, usually at least nearly as long as third and fourth together; elytra with striae not strongly impressed, base scabrous or subscabrous in the females.

D. Second sternite in male concave and carinate, carina sometimes reduced or even obsolete; convex in female, carina absent.

E. Venter of abdomen subopaque in both sexes; second sternite in male very finely, sparsely, obsoletely punctured, in female convex and moderately punctured; elytra of female scabrous at base, subscabrous to about middle; usually larger .. *subscaber* Lec. (p. 17).

EE. Venter of abdomen shining; second sternite with carina absent in female and greatly reduced or even obsolete in male,[4] punctures numerous in both sexes; elytra scabrous only at the base in female; usually smaller.

F. Second sternite broadly rounded in front, very coarsely punctured, anterior margin sharply elevated in female, strongly extended in male; fifth sternite longer than third and fourth together in both sexes; southern Rocky Mountains ..... *robustus*, n. sp. (p. 19).

FF. Second sternite more narrowly rounded in front, less coarsely punctured, anterior margin thick, distinctly elevated in both sexes, but not so strongly extended in male as in foregoing species; fifth sternite in male shorter than third and fourth together; Northwestern States ..... *oregoni*, n. sp. (p. 18).

DD. Second sternite concave in both sexes, anterior margin strongly extended, opaque or shining, carina usually well developed in males at least.

E. Second sternite opaque, finely and more closely punctured, the carina usually well developed in male, usually absent in female. *praeceps* Lec. (p. 20).

EE. Second sternite subopaque or moderately shining, not closely punctured, carina well developed in both sexes, strongly elevated anteriorly in male to form a spinelike process.

F. Larger, more than 2.7 mm long; second sternite subopaque, punctures very fine and sparse, nearly obsolete ..... *opacus*, n. sp. (p. 20).

FF. Smaller, less than 2.4 mm long; second sternite feebly or moderately shining, punctures moderately fine and sparse. *abietis*, n. sp. (p. 21).

BB. Second sternite in both sexes vertical or oblique, not concave, usually convex, armed with a tubercle, spine, or median carina, anterior margin moderate or weak, more extended; other sternites unarmed, except in *multistriatus* and *scolytus*.

[4] When the carina is absent, members of this subgroup may be recognized by the shining venter and the strongly elevated or extended anterior margin of the second sternite.

C. Second sternite with carina or base of tubercle or spine reaching posterior margin.

D. Larger, usually more than 3.6 mm long; second sternite with carina or tubercle on posterior margin in both sexes, often obsolescent in female.

E. Elytral striae distinctly impressed, punctures on interspaces 2 and 3 confused, finer than on striae; venter of abdomen shining, segment 2 with a faint median carina often ending in a small tooth at posterior margin, segments 3 and 4 each with a small rather sharp median tooth on posterior margin, segment 5 impressed in median line and posteriorly, with a strong posterior margin__(*californicus* Lec.) *scolytus* (Fab.) (p. 22).

EE. Elytral striae scarcely impressed; punctures of interspaces in rows and but little finer than those of striae; venter of abdomen subopaque, segment 2 with a small median tooth, often obsolescent in females, segments 3 and 4 unarmed, segment 5 concave with a strong posterior marginal ridge. *ventralis* Lec. (p. 22).

DD. Smaller, usually less than 2.7 mm long; second sternite with a spine in the male, a tubercle in the female; striae more strongly, but variably, impressed, interstrial punctures considerably finer and sparser.

E. Frons of male more vertical, weakly convex, flattened on an area extending only slightly behind the eyes; pronotum more finely and sparsely punctured; elytral striae more strongly impressed; second sternite opaque, very finely and sparsely punctured, base of spine extending to center of segment; fifth sternite nearly as long as third and fourth combined, its posterior outline arcuate. *sobrinus*, n. sp. (p. 23).

EE. Frons of male more sloping, flattened well behind eyes; pronotum less finely, more closely punctured; elytral striae more weakly impressed; second sternite shining or subopaque, punctures stronger; fifth sternite but little longer than fourth, posterior outline arcuate or subangulate.

F. Frons of the male feebly concave, more coarsely aciculate-punctate and with coarser hairs; elytral interspaces not impressed; second sternite shining, with a stout blunt spine, its base extending from posterior margin to well beyond center of segment; fifth sternite little longer than fourth, its posterior outline subangulate_____*laricis*, n. sp. (p. 24).

FF. Frons not concave in either sex, finely to moderately aciculate-punctate, with finer hairs; elytral interspaces feebly impressed; spine on second sternite more slender.

G. Frons in male moderately coarsely aciculate-punctate, slightly convex, the hairs fine and rather short; strial punctures moderate; second sternite shining, base of spine extending past middle of segment; fifth sternite scarcely longer than fourth, its posterior margin subangulately rounded. *fiskei*, n. sp. (p. 25).

GG. Frons of male finely aciculate-punctate, hairs fine and longer, strial punctures finer; second sternite subopaque, base of spine reaching center of segment; fifth sternite with its posterior margin nearly evenly arcuate.
unispinosus Lec. (p. 26).

CC. Second sternite with base of tubercle or spine not attaining the posterior margin.

D. Elytra subtruncate behind, striae strongly punctured, moderately but variably impressed, interspaces not impressed; pronotum distinctly wider than long, strongly constricted near anterior margin; venter of abdomen not closely punctured; second sternite with a spine or tubercle arising from center in both sexes; fifth sternite in male shorter than third and fourth combined.
piceae Swaine (p. 26).

DD. Elytra separately rounded behind, striae and interspaces nearly equally impressed; pronotum scarcely wider than long, moderately constricted near anterior margin; venter of abdomen finely and densely punctured, second sternite with a spine arising from anterior third in both sexes; fifth sternite in both sexes longer than third and fourth combined----------*multistriatus* Marsh. (p. 27).

DESCRIPTIONS OF NORTH AMERICAN SPECIES

SCOLYTUS RUGULOSUS Ratzeburg

Male.—Dark reddish brown to black, with margins reddish brown; 1.8 to 2.3 mm long exclusive of head, about 2.3 times as long as wide.

Front of head varying from slightly convex to flattened, occasionally feebly concave in median area; very finely convergently aciculate, with punctures very fine and inconspicuous, with sparse, fine, cinereous hairs of moderate length; epistomal process nearly obsolete. Eye elongate, scarcely wider above the broad, shallow emargination. Antenna yellowish, club 1.7 times as long as funicle, 1.6 times as long as wide, slightly wider distally.

Pronotum slightly wider than long, posterior outline nearly straight, rounded at posterior angles, sides convergently arcuate, feebly constricted near anterior margin, broadly rounded in front; surface shining, with coarse, rather close, elongate punctures, much denser on sides and in front; posterior and lateral margins strongly developed.

Elytra about equal in width to pronotum; humeri elevated and polished, sides convergently arcuate, separately rounded behind and rather strongly emarginate in sutural region, not dehiscent; margin finely and sharply serrate; surface subopaque, moderately strongly depressed about scutellum, which is wider than long; surface feebly shining, striae and interspaces subequally strongly impressed, and equally, moderately punctured, punctures larger toward base, those from interspaces bearing fine, short, erect hairs; posterior fifth sloping.

Venter of abdomen strongly, obliquely ascending, not excavated, first and second sternites fused, second sternite not margined anteriorly, punctures fine and close, pubescence cinereous, consisting of many short, fine, appressed hairs and a few longer, stouter ones; third and fourth sternites very short, each ornamented by a submarginal row of longer hairs; fifth sternite about twice as long as preceding two combined, not strongly margined behind.

Female.—Frons slightly convex, less flattened and less hairy than in male, but otherwise very similar to male.

This species, introduced from Europe, has become widely distributed in North America. The writer has studied specimens from Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Maryland, the District of Columbia, Ohio, Indiana, Illinois, Michigan, Missouri, Kansas, Colorado, Texas, Louisiana, Mississippi, Georgia, North Carolina, Virginia, West Virginia, and Kentucky. The hosts given include apple, pear, peach, and both the wild and cultivated species of plum and cherry. It has also been reported from quince and nectarine.

SCOLYTUS MUTICUS Say

Male.—Shining black, but often with elytra dark reddish brown; 2.8 to 4.3 mm long exclusive of head, about twice as long as wide; with sparse long hairs over most of surface.

Front of head very broadly flattened, distinctly concave; epistomal margin broadly and strongly emarginate, epistomal process lacking; surface shining, very coarsely aciculate, with sparse, fine, obscure punctures and sparse, very fine, long hairs; finely, densely punctured at margin, with a dense fringe of coarser, longer, incurved, yellow hairs. Eye elongate, wider above, broadly emarginate, its shape usually modified at upper median angle by extreme flattening of head. Antenna yellowish brown, club 1.55 times as long as funicle, 1.55 times as long as wide, ovate, moderately wider distally, sutures angulate.

Pronotum wider than long, widest just behind middle; posterior outline distinctly bisinuate, sides arcuate, rather weakly constricted near anterior margin; surface shining, strongly, moderately closely punctured except in middle half of median line, which is feebly, broadly elevated and devoid, or nearly so, of punctures; punctures coarser at sides, and much denser in anterior constriction; posterior-lateral margin strongly developed; disk glabrous, but with long slender hairs at sides and shorter ones in front.

Elytra about equal to pronotum in width; humeri strongly elevated and polished, sides distinctly arcuate, slightly converging caudad, separately rounded behind, with sutural region broadly, shallowly emarginate; margin obsoletely serrate; surface shining, very strongly depressed in scutellar region, striae and interspaces equally, strongly, coarsely punctured and impressed, interstrial punctures bearing long, slender, yellow hairs; posterior seventh rather weakly depressed and confusedly punctured.

Venter of abdomen shining, strongly, rather closely punctured, with long, slender hairs; second sternite nearly vertical, convex, anterior margin thick, elevated; third and fourth sternites short; fifth sternite with ventral face short at each side, extended and longitudinally impressed in median region, finely, deeply punctured; posterior face concave at each side, very finely, closely punctured and ornamented with a dense tuft of long, dorsally recurved hairs at each side.

Female.—Frons not quite so broadly flattened, slightly less coarsely aciculate, with sparse punctures more conspicuous and fringe of hairs less strongly developed. Elytra distinctly serrate on posterior portion of sides. Fifth abdominal sternite much longer than preceding two combined, and moderately finely, deeply, and closely punctured.

The specimens studied by the writer are all from *Celtis* when the host is cited, and came from New Jersey, Pennsylvania, Maryland, the District of Columbia, West Virginia, Ohio, Kentucky, Kansas, Texas, Mississippi, and Florida.

SCOLYTUS FAGI Walsh

Male.—Dark reddish brown to black, 4.5 mm long exclusive of head, about 2.15 times as long as wide.

Front of head flattened, sometimes feebly concave; epistoma devoid of process, margin broadly emarginate; surface shining, rather densely granulate-punctate, punctures passing over into aciculae near epistoma, ornamented with numerous short, fine, erect, yellow hairs. Eye elongate, scarcely wider above, inner line very broadly and shallowly emarginate. Antenna yellowish brown, club 1.22 times as long as funicle, 1.7 times as long as wide, nearly regularly elliptical, sutures strongly angulate.

Pronotum slightly wider than long, widest just behind the middle, posterior outline nearly straight, sides convergently arcuate, scarcely constricted near anterior margin, very broadly rounded in front; surface shining; punctures on disk fine, moderately spaced, coarser and closer at sides and in the weak anterior constriction; marginal line distinct and elevated on sides and behind.

Elytra very slightly narrower than pronotum, about 1.3 times as long as wide, widest near base, with sides convergently arcuate, broadly rounded behind and slightly emarginate in sutural region; sides feebly serrate, apex entire except in emargination; surface brightly shining, strongly depressed near scutellum; striae strongly impressed (not so strongly as in *quadrispinosus*), punctures coarse, separated by less than their own width; interspaces with much finer, sparse

punctures, usually not impressed; posterior sixth moderately depressed, punctures close and confused, some of them bearing short setae.

Venter of abdomen somewhat concave, brightly shining, coarsely, densely punctured; second sternite oblique, separated from first by an elevated margin; third and fourth sternites short, the two together shorter than the fifth, which is convex, longitudinally impressed, and the ventral face not limited by a raised posterior margin, very densely punctured, posterior face finely and densely pubescent.

Female.—Front of head convex, finely and closely punctured, and ornamented with a few short, fine hairs. Elytra as in male. Venter of abdomen more coarsely punctured; second sternite shorter; fifth sternite much longer than third and fourth together and with a strongly elevated arcuate posterior margin.

This species has been reported from Illinois and Texas, the hosts being *Fagus* and *Celtis*. Several series from Texas have been studied by the writer.

SCOLYTUS SULCATUS Leconte

Type.—Reddish brown (probably immature), 3.43 mm long, exclusive of head, almost exactly twice as long as wide.

Front of head somewhat flattened, finely aciculate-punctate, punctures not conspicuous, with yellow incurved hairs (mostly abraded). Antenna yellowish, club elongate, nearly twice as long as wide, sutures sharply angulate. Eye elongate (21+5), widest above the broad shallow emargination.

Pronotum wider than long, posterior outline bisinuate; widest behind, sides arcuate and converging anteriorly; moderately constricted near anterior margin; surface smooth, shining, finely, moderately closely punctured, more coarsely at sides and in anterior constriction.

Elytra slightly wider than pronotum, sides feebly arcuate and convergent, separately rounded behind, emarginate in sutural region, not dehiscent, posterior border not serrate; surface moderately shining; striae with moderate punctures in definite rows, not at all or very feebly impressed, except at extreme base; interstrial punctures but little smaller; posterior sixth depressed and confusedly punctured.

Venter of abdomen very brightly shining, not strongly concave; anterior margin of second sternite evenly rounded as in *fagi*, not broadly, subtruncately rounded as in *quadrispinosus*; no true tubercles on any of the sternites but with slight indications of a median one on the fourth; fifth sternite longer than third and fourth combined, convex, with no elevated posterior margin, the median line indefinitely impressed.

Female.—Somewhat larger than male (3.23–4.34 mm long). Front of head convex, surface finely convergently aciculate, with fine inconspicuous punctures. Elytra as in male. Venter of abdomen with fifth segment much longer than in male, more strongly punctured, and with an elevated arcuate posterior margin.

Until within the last year no authentic specimen of *S. sulcatus* other than the type had been seen by the writer. In connection with the study of possible insect vectors of the Dutch elm disease, a single specimen was taken from elm by W. D. Buchanan at Chatham, N.J., on September 26, 1933, and three more at the same place on March 25, 1934. These specimens were all dead and partly disintegrated and were of the opposite sex from the unique type. A similar partly disintegrated female was taken on January 19, 1934, at Stamford, Conn., by J. A. Schmidt in connection with the work of the Federal Civil Works Administration. These females were all believed to be *S. sulcatus*, but until associated males were found their identity remained in doubt.

The identity of the species was established beyond a reasonable doubt by several series of specimens taken during the season of 1934. On June 7, A. E. Fivaz collected 4 females and 2 males from green elm bark at Maplewood, N.J., and on June 24 and 28 two other series from elm on Staten Island, N.Y. On July 24, D. O. Wolfenbarger also collected 2 females from elm bark at Yonkers, N.Y. But elm is

not the only host for *S. sulcatus*, for the writer has identified 2 specimens taken from plum at Greenwich, Conn., by F. J. Dillaway and 2 more collected from apple by Manigold at East Orange, N.J.

The fact that *S. sulcatus* has been found on several occasions in elm indicates that this shade tree is a favored, or at least a common, host for this bark beetle. If this is true, this species, until now of only taxonomic interest on account of its rarity, immediately acquires economic importance as a potential vector of the spores of *Graphium ulmi*, the fungus supposed to cause Dutch elm disease.

SCOLYTUS REFLEXUS, new species

Male.—Shining black with elytra piceous; 3.4 mm long, exclusive of head, about 2.4 times as long as wide.

Front of head flattened, subopaque, moderately coarsely aciculate-punctate, with yellowish-brown hairs of moderate length; well-developed epistomal process granulate-punctate, emargination narrower and somewhat deeper than usual, outer angles distinctly elevated. Eye elongate, wider above, broadly shallowly emarginate. Antenna light yellowish brown, club 1.3 times as long as funicle, 1.76 times as long as wide, slightly irregularly ovate, slightly wider distally to the middle, sutures moderately sharply angulate.

Pronotum 1.11 times as wide as long, posterior outline feebly bisinuate, posterior angles rounded, sides arcuate, rather strongly constricted near anterior margin, very broadly, subtruncately rounded in front; surface brightly shining, deeply and strongly, moderately closely punctured on disk, punctures at sides much coarser and those in anterior constriction very dense; posterior-lateral marginal line distinct and strongly elevated.

Elytra slightly narrower than pronotum, about 1.28 times as long as wide; humeri prominent, sides subparallel, feebly arcuate, posterior angles not serrate, broadly rounded, bisinuately emarginate in sutural region behind, scarcely or not at all dehiscent at suture; surface shining; scutellar region depressed as usual; striae often moderately strongly, but variably, impressed, punctures moderately fine and close; interspaces feebly or not at all impressed, punctures much finer; posterior sixth moderately depressed, punctures confused, coarser than on disk and moderately close.

Venter of abdomen brightly shining, moderately strongly punctured; first sternite convex behind, suture separating it from second sternite weakly elevated; second sternite somewhat oblique, nearly vertical, convex, punctures deep and strong, moderately numerous, with no evidence of a median tubercle; third and fourth sternites short as usual, hairs at sides longer, fourth slightly longer than third and with posterior margin weakly bisinuate; fifth sternite greatly modified, portion anterior to margin no longer than fourth, margin very strongly elevated in median region and drawn out to form a slightly recurved subrostriform ridge, portion posterior to margin vertical, more than twice as long as anterior division, finely and densely punctured.

Female.—Usual frontal differences. Elytral striae more strongly impressed, base subscabrous and posterior-lateral margin serrate. Venter similar to that of male, but fifth sternite as long as third and fourth combined, with posterior margin subangulate behind and not so strongly elevated.

Host.—Pseudotsuga taxifolia.

Type locality.—Santa Catalina Mountains, Ariz.

Type.—Catalog no. 43831, United States National Museum.

Type, allotype, and 11 paratypes (Hopkins U.S. 12210) collected at type locality by M. Chrisman; 7 paratypes (Hopkins U.S. 5625) collected at type locality by J. L. Webb; 1 paratype (1568) collected by Hubbard and Schwarz in the Chiricahua Mountains, Ariz., June 18.

SCOLYTUS WICKHAMI, new species

Male.—Shining black, with margins of pronotum and elytra piceous; 3.06 mm long, exclusive of head, about 2.12 times as long as wide.

Front of head flattened, moderately shining, finely aciculate, with rather fine punctures interspersed and with rather sparse and short yellowish hairs; epistomal process scarcely punctate, more narrowly and deeply emarginate than

usual, outer angles feebly elevated. Eye elongate, wider above, broadly and shallowly emarginate. Antenna yellowish brown, club 1.4 times as long as funicle, 1.5 times as long as wide, distinctly wider near distal end, sutures rather bluntly angulate.

Pronotum 1.1 times as wide as long, posterior outline feebly bisinuate, posterior angles rounded, sides weakly arcuate, very strongly constricted near anterior margin, subtruncate in front, subemarginate near median line; deeply, rather strongly, and closely punctured, more coarsely at sides and more coarsely and densely in anterior constriction; marginal line distinct and elevated, especially on sides.

Elytra very slightly wider than pronotum, about 1.22 times as long as wide; humeri prominent; sides feebly arcuate, very broadly conjointly rounded behind, not serrate, feebly dehiscent at suture, apex of each elytron notched opposite third interspace; surface brightly shining; scutellar region depressed; striae variably impressed (rather weakly in the type), punctures moderately fine, rather close (separated by less than their own diameter in first two striae); interspaces feebly or not at all impressed, punctures notably finer; caudal sixth moderately depressed, punctures confused, moderately close.

Venter of abdomen brightly shining, moderately strongly and closely punctured (more closely than in *reflexus*); first sternite nearly horizontal, separated from second by a more sharply elevated margin than in *reflexus*; second sternite nearly vertical and slightly convex, punctures deep, strong, and close, with no median tubercle; third and fourth sternites short, with longer hairs at sides, fourth with posterior margin feebly arcuate in median region; fifth sternite with portion anterior to margin but little longer than either of preceding segments, concave, margin strongly and sharply elevated (but not strongly extended in median region as in *reflexus*), portion posterior to margin vertical, but little longer than anterior part.

Female.—Frons convex, transversely impressed below; surface moderately shining, very finely, often obsoletely, aciculate and with evident, fine punctures; hairs sparse and short. Elytra serrate at sides and behind, very feebly subscabrous at base, more strongly punctured than in male type. Venter of abdomen similar to that of male, but last sternite about as long as third and fourth combined.

Host.—Pseudotsuga taxifolia.
Type locality.—Buena Vista, Colo. (7,900–8,000 feet).
Type.—Catalog no. 43832, United States National Museum.

Type and 4 paratypes collected at the type locality by H. F. Wickham, July 1–6, 1896; allotype and 12 paratypes (Hopkins U.S. 6354) collected at Fort Garland, Colo., and 7 paratypes (Hopkins U.S. 2304) collected at Tercio, Colo., by A. D. Hopkins; 2 paratypes (Hopkins U.S. 9902x) collected in North Cheyenne Canyon, Colo., by G. Hofer, reared May 22, 1914, by H. B. Kirk; 6 paratypes collected July 17, 1907 (Hopkins U.S. 5495), 2 paratypes (Hopkins U.S. 5486), and 13 paratypes collected in the Capitan Mountains, N.Mex., by J. L. Webb; 4 paratypes (Hopkins U.S. 2316a) collected at Vermejo, N.Mex., by A. D. Hopkins; 2 paratypes (Hopkins U.S. 5151) and 4 paratypes (Hopkins U.S. 5044b) collected in the San Francisco Mountains, Ariz., by J. L. Webb; 4 paratypes (Hopkins U.S. 21410g) collected July 24, 1930, and 29 paratypes (Hopkins U.S. 20421, c, d, e) collected July 29, 1930, in the Prescott National Forest, Ariz., by M. W. Blackman; 1 paratype collected July 27, 1923, in Montezuma National Forest, Ariz., by A. Hough; 3 paratypes (Hopkins U.S. 4558p) collected at Kamas, Utah, by H. E. Burke.

This species is more closely allied to *reflexus* than to any other, but the males can be readily distinguished not only by the abdominal characters but by the frontal and elytral characters as well. The separation of the females is more difficult, but the elytra in *reflexus* are more strongly roughened at the base, the second sternite has a less definite anterior margin, and the second and fifth sternites are less closely punctured.

SCOLYTUS TSUGAE Swaine

Male.—Shining black; 2.7 to 3.4 mm long, exclusive of head, about 2.12 times as long as wide.

Front of head slightly convex; epistomal process wide, moderately strongly, broadly emarginate; surface moderately shining, very finely aciculate, with numerous deep, fine punctures, bearing rather short, yellowish hairs. Eye elongate, only slightly wider above the broad shallow emargination. Antenna yellowish brown, club 1.46 times as long as funicle, 1.43 times as long as wide, irregularly oval, widest just distad of the middle, sutures angulate.

Pronotum wider than long, posterior outline nearly straight, rounded at posterior angles, sides arcuate, rather strongly constricted near anterior margin, anterior outline broadly rounded, feebly and broadly emarginate in median area; surface brightly shining, finely, deeply, moderately closely punctured on disk except on median line, which is sparsely or not at all punctate; sides somewhat coarsely and anterior constriction more densely punctured; posterior lateral marginal line fine and distinctly elevated.

Elytra scarcely wider than pronotum, about 1.24 times as long as wide; humeri moderate, sides arcuate, feebly converging posteriorly, broadly, conjointly rounded, margin obsoletely serrate, dehiscent at suture; surface brightly shining; scutellum wider than long, depressed; striae usually strongly, but variably, impressed, punctures moderate in size and spacing; interspaces feebly and variably impressed, with finer and sparser punctures, caudal sixth moderately depressed, with coarser, confused punctures.

Venter of abdomen opaque or subopaque; second sternite vertical, bordered anteriorly by a fine, moderately elevated margin, punctures moderately close and fine; third and fourth sternites short, more finely punctured; fifth sternite shorter than preceding two combined, rather deeply concave, with a strongly and sharply elevated, arcuate, posterior margin.

Female.—Similar to male, but frons convex, with surface smoother, scarcely aciculate, more sparsely and finely punctured, and with fewer hairs. Elytra feebly scabrous at base and finely serrate on posterior-lateral margin. Venter wider, with fifth sternite usually slightly longer than third and fourth combined.

This species was described by Swaine from specimens collected in British Columbia and Alberta from *Tsuga mertensiana* and *Pseudotsuga mucronata* (= *taxifolia*). The writer has studied the types. Additional specimens assigned to this species, all from *T. mertensiana*, are from Washington, Oregon, and California.

SCOLYTUS MONTICOLAE Swaine

Male.—Shining black, often with elytra reddish brown; 2.2 to 2.8 mm long, exclusive of head, about 2.1 times as long as wide.

Front of head flattened, epistomal process broadly and shallowly emarginate; surface feebly shining, finely but distinctly aciculate-punctate, with numerous moderately short, yellowish hairs. Eye elongate, distinctly wider above the broad, shallow emargination. Antenna yellowish brown, club 1.41 times as long as funicle, 1.58 times as long as wide, irregularly oval, slightly wider distally to the middle, sutures moderately angulate.

Pronotum distinctly wider than long, widest just behind middle; posterior margin nearly straight, feebly bisinuate, posterior angles rounded; sides distinctly arcuate, moderately strongly constricted near anterior margin; anterior outline broadly rounded; surface shining, moderately finely, deeply, rather closely punctured, more sparsely in median line, punctures coarser at sides and denser in constriction; marginal line at sides and behind fine but distinct.

Elytra scarcely wider than pronotum, about 1.24 times as long as wide; sides nearly straight; broadly conjointly rounded behind, many specimens notched at apex opposite third interspace; feebly dehiscent at suture, margin not serrate; surface brightly shining; scutellum wider than long, moderately depressed; striae usually weakly, but variably, impressed, punctures rather fine, not close; interspaces usually not impressed, punctures very fine; caudal sixth moderately strongly depressed, more coarsely, closely, confusedly punctured.

Venter of abdomen with second sternite vertical, finely margined in front, surface moderately to brightly shining, finely, moderately sparsely punctured; second and third sternites subopaque to feebly shining, fifth shorter than third and fourth combined, concave, with a strong, sharply elevated, arcuate caudal margin.

Female.—Front convex, surface smoother, and punctures and hairs sparser. Base of elytra feebly scabrous, and posterior-lateral margins finely serrate. Venter of abdomen with second sternite more feebly margined in front and slightly oblique on posterior fourth; fifth sternite longer than third and fourth combined, concave and margined as in male.

This form is very closely allied to *Scolytus tsugae* and specimens assigned to *monticolae* are sometimes found in field series of *tsugae*. Also there are many intergradations between the more coarsely sculptured forms with the ventral abdomen opaque which are representative of *tsugae* and the more smoothly sculptured *monticolae* with the venter shining. The writer is somewhat at a loss in definitely assigning certain of these intermediate forms to either species.

Scolytus monticolae was described by Swaine from specimens taken in British Columbia from *Pinus monticola* and *Pseudotsuga mucronata* (= *taxifolia*). The types have been studied by the writer. Additional specimens assigned to this species are from Oregon, Washington, Idaho, Montana, and Wyoming. The trees serving as hosts were *Pseudotsuga taxifolia*, *Tsuga mertensiana*(?), *Abies grandis*, and *Abies* sp.

SCOLYTUS QUADRISPINOSUS Say **(S. CARYAE** Riley)

Male.—Shining black, with elytra varying from reddish brown to black; ranging in length from 2.9 to 5.0 mm exclusive of head, about twice as long as wide.

Front of head very broadly flattened, slightly concave; coarsely, longitudinally aciculate with sparse, laterally compressed punctures interspersed; ornamented with long brown hairs, rather fine and sparse except for dense border of coarser, longer, incurved hairs; epistomal process strongly elevated at sides, broadly, moderately deeply emarginate. Eye elongate (7+24), wider above, inner line shallowly emarginate. Antenna yellowish brown, club 1.5 times as long as funicle, 1.18 times as long as wide, distinctly wider distally, sutures angulate.

Pronotum slightly wider than long, widest just behind middle, posterior outline bisinuate, sides convergently arcuate, constricted near anterior margin, broadly, subtruncately rounded in front; surface shining, disk finely, moderately sparsely punctured, more coarsely and closely at sides and more densely in anterior constriction; disk glabrous, with rather long yellowish hairs at anterior lateral angles and in front; posterior margin fine but distinct, that at sides stronger.

Elytra about equal in width to pronotum, the length scarcely exceeding the width; sides nearly straight and subparallel on anterior half, convergently arcuate, very broadly, subtruncately rounded behind, with posterior lateral margin strongly serrate; surface shining, strongly depressed in scutellar region; humeri weakly elevated; striae very strongly impressed, punctures coarse and close, smaller near the base; interspaces finely and much more weakly impressed, punctures fine; striae extending nearly to extreme apex and only caudal fifteenth of elytra weakly depressed.

Venter of abdomen very strongly concave; second sternite deeply excavated, anterior margin very strongly produced, with a subacute, strongly recurved process in median line, its posterior face with dense, short hairs; surface opaque, minutely, obsoletely punctured, with a distinct acute median carina, posterior margin usually with a sharp toothlike elevation at each lateral angle; third sternite short, minutely punctured, with three prominent spines, a heavy one at each posterior lateral angle and a more slender one in median line on posterior margin; fourth sternite more strongly punctured, concave, caudal margin sharply elevated, with a sharp median spine (variable in its development), also often with a toothlike elevation at each lateral angle; fifth sternite very short, less than one-third as long as fourth, densely punctured, with rather fine, dense, and short pubescence on its posterior vertical face.

Female.—Frons less broadly and strongly flattened, subconvex, more finely aciculate, with hairs shorter and less numerous but similarly arranged. Venter with second abdominal sternite subvertical, opaque, finely punctured, with fine, short, erect hairs; third sternite short, finely punctured; fourth similar but more strongly punctured; fifth as long as last two together, more coarsely and closely punctured, posterior face with dense short pubescence.

Scolytus quadrispinosus shows considerable variation in the sculpture of the frons, pronotum, elytra, and abdomen. This is especially true of the males, those from the Southern States showing a distinct tendency toward the stronger development of the ventral spines. This usually involves a greater development of the tubercles at the posterior-lateral angles of the second sternite, thus forming a six-spined venter. In two males, however, both from Mississippi, there is an additional long slender spine arising from the second sternite near the posterior margin just at the left of the median carina.

Several thousand specimens of *Scolytus quadrispinosus*, including the type series of *S. caryae* Riley, have been studied by the writer. These include specimens from Connecticut, New York, New Jersey, Pennsylvania, Ohio, Michigan, Wisconsin, Iowa, Missouri, Kansas, Illinois, Indiana, Tennessee, West Virginia, Virginia, the District of Columbia, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Louisiana, and Texas. Swaine also reports it from Utah, Quebec, and Ontario.

The host trees include all species of the genus *Hicoria* occurring in its range, including native and cultivated pecans. The writer has also seen the beetles beginning an attack upon butternut trees (*Juglans cinerea*).

SCOLYTUS SUBSCABER Leconte

Female.—Shining black; 4.0 mm long exclusive of head, about twice as long as wide.

Front of head transversely impressed just behind elevated, broadly and shallowly emarginate epistomal process; convex between eyes, flattened and slightly impressed above upper angle of eye; strongly aciculate above, more feebly below, with interspersed punctures from which arise erect hairs of moderate length. Eye rather finely granulate, elongate, wider above, inner line broadly and moderately shallowly emarginate. Antenna light brown, club 1.6 times as long as wide, wider distally, sutures sharply angulate.

Pronotum wider than long, widest just behind middle; posterior outline bisinuate, nearly straight; sides arcuate, rather strongly constricted near anterior margin; surface shining, with disk finely, obsolescently punctate, punctures coarser and closer in anterior constriction; marginal line fine behind, strongly elevated and coarser at sides.

Elytra wider than pronotum, sides subparallel, feebly arcuate; separately rounded behind, apex feebly emarginate in median region, feebly dehiscent at sutures, margin weakly, finely serrate; surface shining, scabrous at the base; strial punctures moderately fine behind but larger toward base, striae not strongly impressed, but often with very fine impressed lines at one or both sides of strial row; interstrial punctures scarcely finer; punctures both of striae and interspaces often with anterior margins slightly elevated (nauricate), especially on anterior third; posterior sixth rather strongly depressed, densely, rugosely punctured.

Venter of abdomen with first sternite horizontal, punctures moderate, with semierect, backwardly directed yellowish hairs; second sternite opaque or subopaque, nearly vertical, convex, anterior margin fine and not conspicuous, punctures moderately coarse, rather sparse, with no evidence of a median tubercle; third and fourth sternites short, together much shorter than fifth, punctures minute, rather close; fifth sternite somewhat concave, bordered posteriorly by a very strongly elevated, acute, arcuate margin, finely punctured, with a faint, rather indefinite median longitudinal elevation, not a definite carina.

The foregoing description is taken entirely from the type. The type is from Vancouver, British Columbia. Four other specimens from Oregon and California are *Scolytus ventralis*, 2 of them, marked types, being females and the other 2 males.

Aside from the type specimen, the writer has examined more than a dozen specimens of females and nearly as many males, all collected in California by J. M. Miller. Two of these specimens, all that were

in the possession of the writer at the time, were compared directly with the type, which is a female, and found to be identical except for slight individual differences. The series shows the usual range of variation in size and sculpture. The length, exclusive of the head, ranges from 2.88 mm to 4.44 mm; other variations have to do with the size of the punctures on the pronotum, elytra, and abdominal sternites, with the degree to which the elytra show the scabrous or subscabrous condition, and with the shape of the second abdominal sternite, the larger specimens usually having this segment relatively wider.

Male.—From 3 to 4 mm long, not quite twice as long as wide; shining black in color, allied to *Scolytus praeceps.* Front of head broadly flattened from eye to eye; epistomal process prominent, broadly emarginate, more deeply than in female, surface coarsely aciculate-punctate, with rather coarse brownish hairs of moderate length. Pronotum about 1.18 times as wide as long, similar to that of female in shape and sculpture. Elytra similar to those of female except that they are not at all scabrous and the posterior-lateral outline is scarcely or not at all serrate. Venter of abdomen very different, surface opaque and very finely punctured; second sternite bordered anteriorly by a strongly elevated and moderately thick, extended margin, surface opaque, with sparse, very fine, obscure punctures, with a median carinal tubercle on posterior margin; third and fourth sternites short, finely, moderately closely punctured; fifth sternite longer than third and fourth combined, with a strongly elevated, arcuate posterior margin, somewhat concave but with the median area convex, surface opaque, with moderately numerous, fine punctures.

SCOLYTUS OREGONI, new species

Male.—Shining black, elytra piceous; 3.20 mm long, about twice as long as wide.

Front of head flattened well behind the eyes; epistomal process broad, elevated at sides, broadly, rather deeply emarginate; surface moderately finely aciculate, with conspicuous, deep punctures, bearing numerous rather long, moderately fine, yellowish-brown hairs. Eye elongate, notably wider above, inner line broadly and shallowly emarginate. Antenna light yellowish brown, club 1.22 times as long as funicle, 1.7 times as long as wide, irregularly oval, scarcely wider distally to middle, sutures moderately sharply angulate.

Pronotum 1.16 times as wide as long, widest at about middle; posterior outline feebly bisinuate; sides arcuate, distinctly constricted near anterior margin; anterior outline broadly, feebly emarginate; surface shining, with numerous small, rather deep punctures, becoming coarser at sides and in front; posterior and lateral marginal line distinct and strongly elevated.

Elytra slightly wider than pronotum, 1.19 times as long as wide, with humeri prominent; sides feebly arcuate, posterior lateral angles broadly rounded, margin scarcely serrate, dehiscent at suture, with each elytron slightly extended in sutural area; surface moderately shining, scutellar region depressed; striae and interspaces weakly, nearly equally impressed, punctures rather fine and but little finer on interspaces; caudal sixth moderately depressed, confusedly, more coarsely punctured.

Venter of abdomen shining; second sternite vertical, narrowly rounded in front, separated from first by a thick, elevated, and moderately extended margin, with fairly numerous, deep, moderately fine punctures, posterior margin usually with faint trace of a median tubercle; third and fourth sternites short, more deeply punctured; fifth sternite considerably shorter than third and fourth together, concave, with an evenly arcuate, sharply elevated posterior margin.

Female.—Usual secondary sexual differences, with frons transversely impressed below, convex above, finely aciculate-punctate with scantier and shorter hairs. Elytra distinctly but finely scabrous at base, tip finely but evidently serrate. Second abdominal sternite oblique, similar to that of male but less strongly margined in front and with no evidence of a median tubercle; fifth sternite longer than third and fourth combined.

Hosts.—*Pseudotsuga taxifolia* and *Abies concolor.*

Type locality.—Ashland, Oreg.

Type.—Catalog no. 43834, United States National Museum.

Type, allotype, and 15 paratypes (Hopkins U.S. 13399a) collected at the type locality by W. E. Glendenning, February 3, 1919; other

paratypes from the type locality include 6 collected by W. E. Glendenning under Hopkins U.S. 13363b and 4 collected by P. D. Sargent under Hopkins U.S. 14246c; 1 paratype (Hopkins U.S. 63) collected by Hopkins from *Abies concolor* at Grants Pass, Oreg.

SCOLYTUS ROBUSTUS. new species

Male.—Shining black, elytra very dark reddish brown; 3.41 mm long, less than twice as long as wide.

Front of head strongly flattened well behind eyes; epistomal process broad, low, margin rather deeply emarginate; surface moderately shining, strongly aciculate-punctate, and ornamented with fine, brown hairs of moderate length. Eye finely granulate, elongate, considerably wider above, inner line broadly and shallowly emarginate. Antenna yellowish brown, club 1.27 times as long as funicle, 1.68 times as long as wide, irregularly oval, slightly wider just distad of middle, sutures sharply angulate.

Pronotum 1.15 times as wide as long, widest well behind middle; posterior outline feebly bisinuate, posterior angles rounded; sides feebly arcuate, suddenly constricted near anterior border, anterior outline subtruncate; surface brightly shining; glabrous, strongly, deeply, rather closely punctured on disk, more coarsely and closely on sides and in anterior constriction; posterior and lateral marginal line strongly elevated.

Elytra slightly wider than pronotum, about 1.1 times as long as wide; sides subparallel (feebly arcuate), broadly rounded at posterior angles, posterior lateral margin variably, finely serrate; subtruncate behind, very feebly dehiscent at suture; surface shining, scutellar region depressed; striae variably, usually weakly, impressed, punctures deep and strong, not coarse, moderately numerous; interspaces usually not impressed, punctures slightly finer; posterior sixth rather weakly depressed, densely, confusedly punctured.

Venter of abdomen brightly shining; second sternite strongly concave, bordered anteriorly by a strongly elevated, rather thick, liplike margin, strongly, coarsely, rather closely punctured, posterior margin with little or no indication of a median tubercle; third and fourth sternites short, more finely punctured; fifth sternite longer than third and fourth together, more coarsely punctured than preceding two but more finely than second, concave, with a strongly elevated, evenly arcuate posterior margin.

Female.—Similar in general characters, but frons convex, more finely aciculate-punctate, and with shorter and more scanty hairs. Elytra scabrous at base, and posterior-lateral margins distinctly serrate. Anterior margin of second sternite strongly elevated but less strongly extended, more coarsely punctured, and fifth sternite longer.

Hosts.—*Abies concolor, A. lasiocarpa, Pseudotsuga taxifolia.*
Type locality.—Prescott, Ariz.
Type.—Catalog no. 43835, United States National Museum.

Type and 10 paratypes (Hopkins U.S. 20410e) collected July 24, 1930, at the type locality by M. W. Blackman; allotype and 5 paratypes (Hopkins U.S. 9903x) collected at Colorado Springs, Colo., by B. T. Harvey; 5 paratypes (Hopkins U.S. 12244a) reared at Williams Canyon, Colo., by W. D. Edmonston; 5 paratypes (Hopkins U.S. 3951) collected in the Capitan Mountains, N.Mex., by W. F. Fiske; 11 paratypes collected in the Santa Catalina Mountains, Ariz., by J. L. Webb; 4 paratypes (Hopkins U.S. 5666) collected in the Capitan Mountains, N.Mex., by J. L. Webb; 10 paratypes (Hopkins U.S. 11910) collected in El Paso County, Colo., by W. D. Edmonston; 13 paratypes collected in Kaibab National Forest, Ariz., by M. W. Blackman. All the above were taken from *Abies concolor.* In addition, 1 paratype (Hopkins U.S. 4548a) collected from *A. lasiocarpa* at Kamas, Utah, by H. E. Burke; 1 paratype (Hopkins U.S. 3991) collected from *Pseudotsuga taxifolia* at Cloudcroft, N.Mex., by W. F. Fiske.

SCOLYTUS PRAECEPS Leconte

Female.—Black, moderately shining, with elytra reddish brown; 3.0 mm long, about 2.21 times as long as wide.

Front of head convex; epistomal process wide, low, broadly emarginate; surface rather finely aciculate, with rather conspicuous, deep punctures of moderate size, bearing fine, yellowish hairs of moderate length. Eye elongate, slightly wider above, inner line broadly emarginate. Antenna yellowish, club 1.28 times as long as funicle, 1.6 times as long as wide, irregularly oval, widest just distad of middle, sutures angulate.

Pronotum slightly wider than long (46.5:42), widest just behind middle; sides arcuate, moderately constricted near anterior margin; surface shining; punctures deep, moderately fine, and rather numerous, much coarser on sides, and denser in anterior constriction; marginal line distinct behind and more so at sides.

Elytra slightly wider than pronotum, 1.12 times as long as wide; sides subparallel, broadly rounded and feebly emarginate behind, slightly dehiscent at suture, posterior-lateral margin finely, irregularly serrate; moderately depressed about scutellum; surface shining, rather weakly subscabrous at base; striae variably impressed, impressed lines not always corresponding with either striae or interspaces, strial punctures of moderate size, coarser toward base, and separated by more than their own diameter; punctures of interspaces slightly finer; posterior sixth weakly depressed, densely and confusedly punctured.

Venter of abdomen with surface opaque; second sternite nearly perpendicular, separated from first by a well-developed, elevated, acute margin, punctures moderate in size and arrangement, with very fine, short, reclinate hairs, posterior border with a very feeble, scarcely visible, carinal tooth; third and fourth sternites short, opaque, often darker in color, very finely and more closely punctured; fifth sternite longer than third and fourth combined, opaque, very finely punctured, concave, with a sharply elevated, arcuate posterior margin.

Male.—Similar to female but having frons flattened between eyes, more coarsely aciculate-punctate, with coarser, longer, and more numerous hairs; epistomal process more prominent; base of elytra not subscabrous; second abdominal sternite subopaque, more strongly punctured, with anterior margin thicker, strongly elevated, and extended; median carinal tooth more elevated and sometimes with a carinal elevation extending nearly to center of sternite; fifth sternite shorter.

The description of the female is taken from the type.

Specimens of this species have been studied from California, Arizona, New Mexico, and Texas. The host trees are species of *Abies*, especially *A. concolor*.

SCOLYTUS OPACUS, new species

Male.—Shining black, with elytra dark reddish brown; 2.77 mm long, exclusive of head, about twice as long as wide; closely allied to *Scolytus abietis* but larger.

Front of head sloping, flattened on area extending well behind eyes, moderately finely aciculate-punctate, with rather short yellowish-brown hairs; epistomal process low, rather broadly, shallowly emarginate. Eye elongate, considerably wider above, inner line shallowly emarginate. Antenna yellowish brown, club 1.42 times as long as funicle, 1.64 times as long as wide, slightly irregularly oval, widest at about middle, sutures moderately angulate.

Pronotum 1.15 times as wide as long, widest at about middle; posterior outline feebly sinuate, sides arcuate, distinctly constricted near anterior margin, very broadly, subtruncately rounded in front; surface moderately shining, glabrous on disk; punctures deep, moderate in size and distribution, coarser and closer on sides, and denser in anterior constriction; posterior marginal line distinct, that on sides more strongly elevated.

Elytra wider than pronotum, about 1.16 times as long as wide, widest at about the middle, with sides weakly arcuate, individually rounded behind and shallowly emarginate in sutural region; posterior-lateral margin finely, irregularly serrate; surface moderately shining, glabrous on disk; striae, except first two, feebly or not at all impressed, punctures fine, not close; interspaces with punctures but little finer than those of striae, not impressed; caudal portion moderately strongly depressed, with punctures dense and confused.

Venter of abdomen with second sternite concave, bordered anteriorly by a strongly elevated, liplike margin, surface subopaque, punctures very fine and sparse, with a wide, strongly elevated, blunt carina extending from posterior margin to a point well in front of the center, where it is strongly extended to form a conspicuous, well-developed, blunt spine; remaining sternites opaque, very finely, moderately closely punctured, fifth as long as preceding two combined, concave, with a strongly and sharply elevated, arcuate posterior margin.

Female.—A form believed to be the female of this species is similar in general characters, with frons convex, transversely impressed just above epistomal margin, finely aciculate and with moderately fine punctures bearing short dark brown hairs; pronotum more finely punctured; elytra feebly subscabrous at base; venter opaque; second sternite bordered anteriorly by a liplike margin nearly as strong as in male, with a feebly elevated blunt median carina extending from posterior margin to middle; posterior sternites all longer than in male, fifth considerably longer than third and fourth together.

Host.—*Abies lasiocarpa.*

Type locality.—Ouray, Colo.

Type.—Catalog no. 43836, United States National Museum.

Type and 1 paratype collected in July 1897 at Ouray, Colo., at an elevation of 7,500–8,000 feet by H. F. Wickham; allotype and 2 paratypes (Hopkins U.S. 16973a) collected in Glacier National Park, August 24, 1923, by J. C. Evenden; 1 paratype collected July 18 at Brightons, Utah, by Hubbard and Schwarz.

SCOLYTUS ABIETIS, new species

Male.—Dark reddish brown, nearly black, with elytra lighter in color; 2.0 to 2.4 mm long (type 2.1 mm) exclusive of head, nearly exactly twice as long as wide.

Front of head flattened on an area extending to just back of eyes, convex above, feebly concave below; epistomal process widely and shallowly emarginate; surface finely aciculate-punctate, with fine, long, light yellow hairs. Eyes elongate, inner line feebly emarginate. Antenna much lighter in color, club 1.32 times as long as funicle, 1.66 times as long as wide, irregularly oval, widest near middle, suture rather broadly angulate.

Pronotum 1.13 times as wide as long, widest near posterior border; posterior outline nearly straight; sides feebly, convergently arcuate, strongly constricted near anterior margin; surface shining, glabrous on disk, punctures moderately fine, much coarser on sides and denser in anterior constriction; marginal line distinct on sides and behind.

Elytra slightly wider than pronotum, about 1.16 times as long as wide; nearly straight and subparallel at sides, individually rounded behind and shallowly emarginate in sutural region, margin behind irregularly, finely serrate; surface moderately shining, glabrous on disk; striae, aside from the first two, feebly or not at all impressed, punctures moderately fine, moderately close; interspaces more finely and sparsely punctured; caudal portion moderately depressed, with punctures very dense, confused, some of them bearing setae.

Venter of abdomen with second sternite concave and bordered anteriorly by a strongly elevated, rather thick, liplike margin, surface moderately shining, punctures sparse and moderately fine, with a wide, strongly elevated, blunt carina extending from posterior margin to a point well in front of center and most strongly elevated anteriorly where it is sometimes extended to form a short, blunt spine; third and fourth sternites short, subopaque, very finely and closely punctured; fifth sternite nearly as long as third and fourth combined, concave, with a strongly elevated, arcuate posterior margin.

Female.—Front of head convex, transversely impressed below, finely aciculate-punctate, with the fine hairs shorter than in male. Base of elytra weakly scabrous. Second abdominal sternite less strongly margined anteriorly, with median carina much more feebly developed and usually extending scarcely to center of segment; fifth sternite longer than third and fourth combined.

Host.—*Abies grandis.*

Type locality.—Sandpoint, Idaho.

Type.—Catalog no. 43837, United States National Museum.

Type, allotype, and 21 paratypes (Hopkins U.S. 224) were taken at the type locality, June 20, 1899, by A. D. Hopkins; 5 paratypes (Hopkins U.S. 222) taken by the same collector at the type locality

June 2, 1899; 1 paratype collected by Wickham at Coeur d'Alene, Idaho; 6 paratypes (Hopkins U.S. 16952a) collected at Coeur d'Alene, Idaho, by H. J. Rust.

SCOLYTUS VENTRALIS Leconte

Male.—Shining black, with elytra reddish brown; 3.71 mm long exclusive of head, about twice as long as wide.

Front of head somewhat flattened; epistomal process wide, outer angles elevated, broadly, fairly deeply emarginate; surface moderately coarsely aciculate-punctate, often with a median longitudinal smooth area on epistoma; hairs yellowish brown, moderate in number and length. Eye elongate, much wider above, inner line feebly, very broadly emarginate. Antenna yellowish brown, club 1.3 times as long as funicle, 1.65 times as long as wide, irregularly ovate, wider near distal end, sutures angulate.

Pronotum wider than long, widest at about the middle; posterior outline feebly bisinuate; sides distinctly arcuate, strongly constricted near anterior margin, anterior outline very broadly subtruncately rounded; surface smooth, shining, punctures on disk rather fine, moderately numerous, much coarser on sides and coarser and closer in anterior constriction; marginal line fine but distinct behind, much stronger at sides.

Elytra slightly wider than pronotum, sides subparallel (feebly arcuate), broadly, conjointly rounded behind, posterior-lateral margin finely serrate; dehiscent at suture; surface shining; striae feebly and variably or not at all impressed, punctures moderately fine, not close, slightly coarser toward base; interspaces with slightly finer punctures; caudal sixth moderately depressed, closely, rugosely punctured, with a few setae.

Venter of abdomen opaque or subopaque; second sternite nearly vertical, strongly margined anteriorly, convex in median area, moderately finely and sparsely punctured, posterior margin with a sharp, elevated, median carinal tubercle; third and fourth sternites short, more finely and closely punctured; fifth sternite nearly as long as third and fourth combined, concave, with a very strongly elevated, evenly arcuate, acute posterior margin.

Female.—Frons convex above, transversely impressed just above epistomal margin, with a short, elevated, median carina bridging the impression; surface moderately finely punctured and weakly aciculate, with short sparse hairs. Elytra scarcely scabrous at base, more strongly serrate on posterior-lateral margin. Venter opaque or subopaque; second sternite more convex in median area, more weakly margined anteriorly, and with only faint traces or none at all of median tubercle; fifth sternite longer than third and fourth combined.

The description of the male, with the exception of the details of antennal structure, is taken entirely from the type.

Specimens of this species studied by the writer were collected in British Columbia, Washington, Oregon, California, Idaho, Montana, Utah, Arizona, and New Mexico. The hosts are *Abies concolor*, *A. grandis*, *A. lasiocarpa*, *Pseudotsuga taxifolia*, *Picea engelmannii* (one lot), and *Tsuga mertensiana*. The species is not only widely distributed but variable in certain characters. The specimens from Utah, Arizona, and New Mexico usually have the venter of the abdomen more opaque and more coarsely punctured than those occurring in the Pacific Coast States.

SCOLYTUS (CALIFORNICUS Leconte) [1] SCOLYTUS (Fabricius)

Female.—Pronotum shining black, elytra reddish brown; 4.0 mm long exclusive of head, about 2.18 times as long as wide.

Front of head convex, transversely impressed above the elevated, emarginate epistomal process, slightly flattened well above the eyes, finely densely granulate-punctate in median area, more coarsely punctured toward sides, with very fine, short, erect hairs (mostly abraded in type). Eye elongate, widest above, inner line broadly, rather shallowly emarginate. Antenna not present beyond second joint of funicle.

[1] New synonymy.

Pronotum slightly wider than long, widest posteriorly; posterior outline bisinuate, sides arcuate, distinctly narrowed anteriorly, rather weakly constricted near anterior margin, anterior outline broadly, shallowly emarginate; surface smooth, shining, punctures at center of disk fine, but becoming coarser and deeper laterally and anteriorly; marginal line distinct.

Elytra slightly wider than pronotum, sides feebly arcuate and converging posteriorly; separately rounded behind and emarginate in the sutural region, not dehiscent at suture; surface moderately shining, striae distinct, rather strongly impressed, punctures moderately coarse and close; interspaces wide, confusedly punctured in second and third interspaces; posterior sixth depressed, with punctures confused, coarser, some of them bearing setae.

Venter of abdomen shining, rather finely but deeply and densely punctured; first sternite convex, with very fine, moderately long hairs (mostly abraded); second sternite oblique, convex with a faint median carina; third and fourth sternites short, each with a distinct rather sharp tubercle at middle of posterior margin; fifth sternite longer than third and fourth together, somewhat impressed in median line, with a strongly elevated, posterior margin.

The foregoing description was prepared from Leconte's type of *Scolytus californicus*, but as the description was written it was compared point by point with authentic specimens of *S. scolytus* from France, Germany, and Russia. The agreement, not only in general characters but in all essential details of structure, with the females of *S. scolytus* is complete. It seems probable, therefore, that this specimen received by Leconte from Andrew Murray was incorrectly labeled as to its source. No other specimen even approaching it in structure has been seen from North America.

A second specimen in the Leconte collection labeled "*S. californicus*" but not mentioned by Leconte is a male of *S. oregoni*.

While it is not known that *Scolytus scolytus* has become established in this country, it is by no means improbable that it has or, if not now established, that it will soon become so. During the summer of 1933 numerous interceptions of both this species and *S. multistriatus* were made in shipments of elm logs from France. These logs, many of which were heavily infected with the Dutch elm disease, were also heavily infested with *S. scolytus* in all stages and also with the smaller elm bark beetle (*S. multistriatus*) and with *Pteleobius kraatzi* Eichh., another bark beetle attacking elm.

SCOLYTUS SOBRINUS, new species

Male.—Shining, piceous black, elytra dark reddish brown; 2.65 mm long, about 2.07 times as long as wide.

Front of head slightly convex, on an area extending only slightly behind eyes, transversely impressed above the low, broad epistomal process; surface shining, finely aciculate-punctate (slightly more coarsely than in *unispinosus*), with moderately long, slender, yellowish-brown hairs. Eye elongate, wider above, inner line very broadly and shallowly emarginate. Antenna testaceous, club 1.35 times as long as funicle, 1.5 times as long as wide, irregularly oval, widest at about the middle, suture rather broadly angulate.

Pronotum slightly wider than long, widest behind middle, posterior outline bisinuate; sides distinctly arcuate, constricted near anterior margin, which is very feebly and broadly emarginate; surface brightly shining, piceous except in anterior constriction; moderately finely, not densely punctured, more densely on sides and in anterior constriction; glabrous except at sides and in front; marginal line sharp and distinct on both posterior and lateral margins.

Elytra slightly wider than pronotum, about 1.2 times as long as wide; sides subparallel (very feebly arcuate), broadly conjointly rounded behind; hind margin not serrate, feebly dehiscent at suture; surface shining; striae usually strongly (but variably) impressed, punctures moderately fine (coarser than in either *unispinosus* or *laricis*, rather distant, deep; interspaces not impressed, punctures finer and rather distant; caudal area moderately depressed, punctures confused, rather close, some bearing setae.

Venter of abdomen subopaque; second sternite not strongly margined anteriorly, nearly vertical, convex, punctures very fine and sparse, with a conspicuous, stout, blunt spine, apex circular, but base compressed and usually extending from posterior margin nearly or quite to center of sternite; third and fourth sternites short, opaque, minutely punctured; fifth not quite so long as preceding two combined, opaque, minutely punctured, concave, with a strongly elevated, subarcuate posterior margin.

Female.—Front of head transversely impressed just above epistomal margin, strongly convex, with sparser and shorter hairs. Base of elytra finely subscabrous, posterior-lateral margin finely serrate. Second sternite bearing a sharp, conical, median tubercle.

Host.—*Pseudotsuga taxifolia.*
Type locality.—Kent, Wash.
Type.—Catalog no. 43838, United States National Museum.

Type, allotype, and 4 paratypes (Hopkins U.S. 4190a) collected at the type locality by H. E. Burke; 24 paratypes bearing identical data except for different lot numbers; 6 paratypes (Hopkins U.S. 14238b) collected at Little Applegate River, Oreg., by J. E. Patterson; 3 paratypes (Hopkins U.S. 14264t) collected in flight at Ashland, Oreg., by F. P. Keen; 5 paratypes (Hopkins U.S. 6107) taken at Jackson, Wyo., by A. D. Hopkins.

This species is closely related to *Scolytus unispinosus* and *S. laricis*. It differs from both, however, in the frontal characters, in the punctation of both pronotum and elytra, and in the structure of the abdominal sternites.

SCOLYTUS LARICIS, new species

Male.—Shining black with the elytra dark reddish brown to black, 2.0 to 2.6 mm long (type 2.37 mm), exclusive of head, about 2.1 times as long as wide; similar to *Scolytus unispinosus* but usually larger, more coarsely punctured, and differing in frontal and abdominal characters.

Front of head strongly flattened and slightly concave on area extending well behind eyes, strongly punctured and rather coarsely aciculate, often converging to meet a slightly elevated median longitudinal carina, ornamented with numerous moderately coarse, rather long, yellowish-brown hairs; epistomal process broad, rather low, broadly, moderately deeply emarginate. Eye elongate, very broadly, rather shallowly emarginate in front. Antenna yellowish brown, club 1.33 times as long as funicle, 1.77 times as long as wide, irregularly oval, widest distally to middle, sutures rather broadly angulate.

Pronotum 1.11 times as wide as long, widest just behind the middle; sides distinctly arcuate, distinctly constricted near anterior margin, surface shining, moderately finely and closely punctured, glabrous except at anterior and lateral borders; posterior marginal line distinct, more strongly elevated at sides.

Elytra slightly narrower than pronotum, 1.22 times as long as wide; sides subparallel (feebly arcuate), broadly, conjointly rounded behind, hind margin not serrate, scarcely at all dehiscent at suture; surface shining, glabrous except at sides and in posterior depression, moderately deeply impressed near scutellum, striae variably impressed on disk, punctures moderately fine, deep (distinctly coarser and slightly closer than in *unispinosus*); interspacial punctures finer; caudal portion moderately depressed, punctures here and on sides numerous, deep, close, and not regularly arranged, with numerous setae.

Venter of abdomen with second sternite feebly shining, convex, not so nearly vertical as in *unispinosus* and more strongly margined anteriorly, punctures deep, moderately fine, with the very conspicuous median spine much stouter than in *unispinosus*, strongly compressed from base to apex, with base extending from caudal margin nearly or quite three-fourths of length of segment; remaining sternites subopaque, short, finely punctured, fifth concave with a strongly elevated, subangulate posterior margin, considerably shorter than third and fourth combined.

Female.—Front subconvex, slightly flattened in front, finely punctate-aciculate, and with finer and shorter hairs. Elytra with base somewhat scabrous and striae more strongly impressed. Second ventral segment broader, and with spine replaced by a conical tubercle, fifth segment longer than third and fourth combined.

Host.—Larix occidentalis.
Type locality.—Moscow, Idaho.
Type.—Catalog no. 43839, United States National Museum.

Type, allotype, and 21 paratypes (Hopkins U.S. 225d) taken on Cedar Mountain, near Moscow, Idaho, June 4, 1899, by A. D. Hopkins; 2 paratypes (Hopkins U.S. 8530) collected at Columbia Falls, Mont., by Josef Brunner; 5 paratypes (Hopkins U.S. 16313a) taken at Coeur d'Alene, Idaho, August 8, 1918, by J. C. Evenden.

SCOLYTUS FISKEI, new species

Male.—Shining black, with elytra very dark reddish brown; 2.77 mm long, exclusive of head, about 2.1 times as long as wide.

Front of head sloping, flattened well behind the eyes, not concave; surface shining, rather coarsely aciculate, with rather fine punctures interspersed, from which arise fine, moderately short hairs (less numerous, finer, and shorter than in *laricis*); epistomal process moderately broad and low, moderately deeply and broadly emarginate. Eye elongate, widest above, with inner line very broadly, rather shallowly emarginate. Antenna lighter in color, club 1.41 times as long as funicle, 1.45 times as long as wide, irregularly ovate, widest distally to middle, sutures strongly angulate.

Pronotum wider than long, widest just behind middle; sides arcuate, constricted near anterior margin, broadly subtruncately rounded in front; surface shining, moderately finely and closely punctured (as in *laricis*), coarser on sides and denser in anterior constriction; glabrous except at anterior and lateral borders; marginal line distinct and strongly elevated.

Elytra wider than pronotum, about 1.23 times as long as wide; sides subparallel; broadly, conjointly rounded behind, hind margin scarcely at all serrate, weakly dehiscent at suture; surface shining, disk glabrous, moderately deeply depressed near scutellum; striae variably impressed, punctures moderately fine, deep, variable in spacing but moderately close on first two striae; interspaces sometimes feebly impressed, punctures much finer; caudal sixth rather strongly depressed, punctures confused, coarser and closer and some of them bearing setae.

Venter of abdomen with second sternite nearly vertical, moderately margined anteriorly, surface shining, punctures sparse, moderately fine, deep, median spine longer than in *laricis*, not so stout and strongly, laterally compressed, with base extending from posterior border about three-fourths the length of the segment; remaining sternites moderately shining, short, finely, more closely punctured, fifth but little larger than either third or fourth, concave, with a strong, elevated posterior margin.

Female.—Usual sexual differences, with frons convex and less hairy. Elytra subscabrous at base and feebly serrate on posterior lateral margins. Second sternite more convex, with median spine reduced to a sharp, conical tubercle, and fifth sternite longer than third and fourth combined.

Host.—Pseudotsuga taxifolia.
Type locality.—Capitan Mountains, N.Mex.
Type.—Catalog no. 43840, United States National Museum.

Type, allotype, and 5 paratypes (Hopkins U.S. 3959) collected April 25, 1907, at the type locality by W. F. Fiske; 4 paratypes (Hopkins U.S. 9914k) taken at Larkspur, Colo., by W. D. Edmonston; 4 paratypes (Hopkins U.S. 5700a) collected in the Sacramento Mountains, N.Mex., by J. L. Webb; 2 paratypes (Hopkins U.S. 6354) collected at Fort Garland, Colo., by A. D. Hopkins.

This species is closely related to *Scolytus laricis* but is slightly larger, the frons of the male is not concave and is less hairy, the venter of the abdomen is more shining, the spine on the second sternite is longer and less stout, and the last sternite is shorter.

SCOLYTUS UNISPINOSUS Leconte

Male.—Shining black; 2.4 mm long (exclusive of head), about 2.15 times as long as wide.

Front of head sloping, flattened to a point well behind eyes, impressed between eyes; surface shining, very finely aciculate-punctate, with very fine light-colored hairs of medium length; epistomal process moderately wide, low, not strongly emarginate. Eye elongate, wider above, inner line very broadly, feebly emarginate. Antenna testaceous, club 1.44 times as long as funicle, 1.47 times as long as wide, irregularly ovate, widest distally to middle, sutures moderately angulate.

Pronotum wider than long, widest at about middle, posterior outline feebly bisinuate, sides rounded, constricted in front; surface moderately shining, black except at anterior margin; finely, not densely punctured, more densely and coarsely in anterior constriction; glabrous except at borders; margin distinct posteriorly, still more distinct at sides.

Elytra scarcely wider than pronotum, sides subparallel, very broadly rounded (subtruncate) behind; posterior margin not serrate, feebly dehiscent at suture; surface shining, glabrous except at sides and in posterior depression; deeply impressed in scutellar region; striae variably impressed on disk, punctures moderately fine and deep, not close; punctures of interspaces much finer, some of interspaces variably, more weakly impressed; striae with punctures not in regular rows; caudal sixth moderately depressed, the punctures irregularly arranged, dense, some of them bearing setae.

Venter of abdomen with second sternite nearly perpendicular, feebly convex, subopaque, with sparse rather fine punctures, with a stout, obtuse, compressed spine directed caudad, its base extending from posterior margin to middle of segment; third and fourth sternites short, subopaque, finely, moderately closely punctured; fifth sternite shorter than third and fourth together, concave, with a strongly elevated, arcuate posterior margin.

Female.—Similar to male in general characters, but front of head convex, more finely aciculate-punctate, and with shorter hairs. Base of elytra feebly scabrous. Spine on second sternite replaced by an acute conical tubercle.

The foregoing description of the male was prepared entirely from Leconte's type with the exception of the details of antennal structure. In his description Leconte mentions two specimens, both from Oregon, but only one specimen is now in the collection at Cambridge, Mass.

Scolytus unispinosus is a common species in *Pseudotsuga taxifolia.* Specimens have been studied by the writer from California, Oregon, Washington, and British Columbia. Allied species occur throughout the Rocky Mountian region.

SCOLYTUS PICEAE Swaine

Male.—Shining, black, or nearly so; 2.2 to 3.1 mm long, exclusive of head, about 2.1 times as long as wide.

Front of head flattened to well behind eyes, distinctly impressed between eyes; epistomal process short, broad, rather low, rather broadly emarginate; surface coarsely punctate-aciculate, the rather coarse, deep punctures bearing moderately slender yellowish-brown hairs of moderate length. Eyes elongate, with front margin broadly but shallowly emarginate. Antenna yellowish brown, club 1.4 times as long as funicle, 1.66 times as long as wide, the shape irregularly oval, widest near middle, sutures angulate.

Pronotum 1.12 times as wide as long, widest behind; sides convergently arcuate, strongly constricted near anterior margin, which is lighter in color; surface brightly shining, glabrous except at anterior and lateral margins, moderately coarsely punctured, more coarsely and densely on sides and in front; posterior marginal line sharp and distinct and continued at sides to anterior constriction.

Elytra very slightly wider than pronotum, 1.13 times as wide as long; sides subparallel, feebly arcuate, rounded at posterior angles, subtruncate behind; color dark reddish brown to black; surface shining, glabrous except at sides and in posterior depression, deeply impressed near scutellum; striae variably impressed, more strongly at base and behind, strial punctures moderately coarse, deep; those of interspaces finer; caudal region slightly depressed, punctures here and on sides confused, bearing setae.

Venter of abdomen with rather coarse punctures and slender hairs; second sternite separated from first by a rather weakly elevated margin, with a long, slender, rather blunt spine arising from its center and directed obliquely downward; third and fourth sternites short, opaque; fifth sternite slightly shorter than third and fourth together, concave, with a strongly elevated, arcuate posterior margin.

Female.—Differing from male in that front of head is convex above, transversely impressed on epistoma, more finely punctate-aciculate, and with shorter hairs. Elytra with the base somewhat scabrous and the striae more impressed. Spine on second sternite more slender and often shorter and conical; fifth sternite longer than third and fourth combined.

This species was described by Swaine from specimens collected at Hudson, Quebec, from white spruce. The writer has studied specimens from Maine, New York, Michigan, Wisconsin, South Dakota, North Dakota, Montana, Colorado, Wyoming, and Manitoba. The hosts, where data were given, were *Picea canadensis*, *P. rubens*, *P. engelmannii*, *Larix laricina*, and *Abies balsamea*. In certain sections, as in Maine and in the Western States, the ventral spine in the female is usually but little smaller than in the male, although females having the much reduced spine are sometimes found. In other sections, as in Michigan and Wisconsin, a considerable proportion of the females have the ventral spine much shorter than do the males.

SCOLYTUS MULTISTRIATUS Marsham

Male.—Dark reddish brown in color with the pronotum mostly black; 2.2 to 3.0 mm long, exclusive of head, 2.03 times as long as wide.

Front of head flattened to well behind eyes; epistomal process short and low, broadly, strongly emarginate anteriorly; surface aciculate, with ridges slightly converging and often joining in median line to form a carina, distinctly, deeply punctate, with numerous fine, rather long, incurved yellow hairs except near median line. Eye elongate, with inner line broadly and shallowly emarginate. Antenna yellowish brown, club 1.61 times as long as funicle, 1.58 times as long as wide, slightly irregularly ovate, widest just distad of middle, sutures sharply angulate.

Pronotum slightly wider than long, widest at middle, posterior outline feebly bisinuate, sides arcuate, moderately constricted near anterior margin; surface shining, glabrous on disk; punctures close, moderately fine, denser and coarser on sides and in front; marginal line at back and sides fine but distinct.

Elytra slightly wider than pronotum, about 1.3 times as long as wide; sides feebly arcuate, broadly rounded behind and feebly emarginate at suture; surface shining, glabrous on disk; striae impressed, with rather close, moderately fine punctures; interspaces nearly equally striate and with finer punctures; caudal sixth moderately depressed, punctures confused and bearing setae.

Venter of abdomen finely and densely punctured; second sternite nearly vertical, rather sharply margined anteriorly, with a rather long, subcapitate spine arising from its anterior third; third and fourth sternites short, each usually with a small median tubercle on posterior margin; fifth segment longer than third and fourth combined, concave, with a sharply elevated, arcuate posterior margin.

Female.—Usual frontal differences and ventral spine usually smaller.

This species is a European form which has been accidentally introduced into the Eastern States and breeds in dead or injured elm. It was first observed in Cambridge, Mass., in 1909 and reported by Chapman (*9*) the following year. Specimens taken in Massachusetts, Connecticut, Long Island, N.Y., New Jersey, and Pennsylvania have been studied by the writer, as well as series from Germany, France, and Russia.

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